

Chapter 4

PRELIMINARY ANALYSIS of a "Red Material" 1992

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Subject

Preliminary Analysis, Red Material

Sample

About one kilogram of red substance was submitted for analysis and a protocol. This material originated from a cave at Qumran and is suspect "Pitum HaQetorit" — incense composition used in conjunction with the Temple worship of ancient Israel.

Preliminary Testing Protocol

The preliminary test protocol consists of the following:

1. Bulk Density Determination.
2. pH Determination of Suspension.
3. Determination of Ash Content.
4. Observation of Ash & Material Reaction with Acid.

Bulk Density

The bulk density was determined by grinding the MATERIAL in a mortar and removing large aggregates and tamping the resulting fine powder via vibration in a graduate of known volume and weighing said material that occupied the volume.

The Bulk Density is: 0.960-0.982 g./cc.

pH Determination of Suspension

A suspension was made of the MATERIAL in distilled water and pH readings taken between 3-30% of cumulative additions to the water.

The pH range of Suspensions are 6.0-6.7

Ash Determination

A porcelain crucible was charged with a random sample of MATERIAL which amazingly weighed exactly 26.0 grams. The sample was placed in a muffle furnace and ashed for 1 hour at 1000 degrees C. The residue was weighed.

The Percent Ash Composition = 52.7%

Acid Reaction

The ASH RESIDUE and original MATERIAL were subjected to diluted HCl contact. The original material fizzed giving off carbon dioxide. The Ash Residue reacted violently giving off some carbon dioxide, but giving off much heat indicative of a strong alkali composition. The HCl solution was colored a green yellow typical of iron chloride complex. The interpretation of these and the previous results follow.

Composition of Incense

The "Pitum HaQetoret" is referred to in the TORAH as "Qetorit HaSamim" (Exodus 39:38). Ingredients specifically delineate there are as follows (Ex. 30:34-35):

"Take unto you SAMIM NATAF, and SHECHAYLET and CHELBONA SAMIM and pure LEVONA and there shall be equal proportions by weight. And you shall make incense of it, a perfume after the art of a perfumer, seasoned with salt pure and holy."

The Talmud gives a more detailed formula (Kritot 6a). The following table gives the Hebrew terminology of the ingredient followed by a translation culled from various sources by the author of this report, together with the units found in the Talmud and a percentage composition based on approximations. The problem arising in the approximations are that the MANEH measurement is a weight measure and the SEAH and KAV are liquid and dry volumetric measures and approximations of the materials themselves which are not really known are educated guesses. Accordingly the Cypriot Wine and Karsina Lye have been "guesstimated."

The percentage compositions are by weight and the total formulation as presented in the Talmud per our estimates is for a process batch weighing 301.4 Kilograms or 663.2 lbs. According to the Israeli Wine Institute at Rehovot, (Dr. Marina Goldman) the Cypriot wine after 2000 years will have lost 70% of its water/alcohol content by weigh and leave a heavy red residue which would itself leave an ash of about 7% when treated in the muffle furnace. As for the spices they would begin to lose their aromatic factors and form some nitrogen bases in the process; however, their further decomposition would be crude potassium carbonate similar to Wyoming Trona. However, carbonic acid would form

<u>NO.</u>	<u>INGREDIENTS(Heb.)</u>	<u>TRANSLATION</u>	<u>AMOUNT</u>	<u>% COMP</u>
1.	Tzawri	Balm	70 maneh	13.0
2.	Tziporen	Onycha	70 maneh	13.0
3.	Chelbona	Galbanum	70 maneh	13.0
4.	Levona	Frankincense	70 maneh	13.0
5.	Mohr	Myrrh	16 maneh	3.0
6.	Ketzia	Cassia	16 maneh	3.0
7.	Shibolet Naird	Spikenard	16 maneh	3.0
8.	Charkom	Saffron	16 maneh	3.0
9.	Kosht	Costus	12 maneh	2.2
10.	Kilupa	Cinnamon Bark	3 maneh	0.6
11.	Kinamon	Cinnamon	9 maneh	1.7
12.	Borit Karhina	Karsina Lye	9 kavim	14.3
13.	Yain Kafrisin	Cypriot Wine	3 seaim/3 kavim	16.8
14.	Melach Sedomit	Sodom Salt	+ kav	0.3
15.	Maaleh Ashan	Smoke Producer	Kol Shehu	0.1

and begin to neutralize the lye to pH's in the 6-7 range by buffer action. Accordingly, the conclusions which follow from our preliminary analysis fit this thesis.

INTERPRETATION AND CONCLUSIONS

The density indicates that the MATERIAL (PK) which is lighter than water is excluded from the category of "red soil" or red minerals such as hematite.

The fact that the PK ashed indicates that it is organic. The fact however, that there is a high percentage = 52.7% of ash, coupled with the fact that the ash tested alkali typical of plant source ash residue indicates that PK is most probably composed of substances akin to authentic PK. The verification of carbonate in the ash underscores the thesis. Authentic PK containing Sodom Salt and Karsina Lye freshly prepared would in itself give an ash accountable to these 2 ingredients alone of 14.6%.

If the Cypriot Wine solvent mix evaporated over

the ages it would account for a new composition higher in ash of theoretical composition of 22.1%. This would mean that the residual ash corrected for organic content would be 31.2%. Which is a reasonable figure for approximately partially petrified organic material.

The fizzing and release of carbon dioxide upon acid treatment of the material coupled with the pH measurement indicates further that age transformed the material towards neutral pH values accountable to carbonic acid sequestration and its Karsina Lye ingredients. However, mulch/petrification chemistry is a complex subject beyond the scope of this report.

Accordingly, the next step is to obtain verification of the organic components of PK via Mass Spectrometry.

Signed: Marvin S. Antelman, Chemical Advisor

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Chapter 5

Palynological Assessment of "The Qumran Spices"

May 5, 1994

by

Dr. T. Hutter
Palynological Analyst

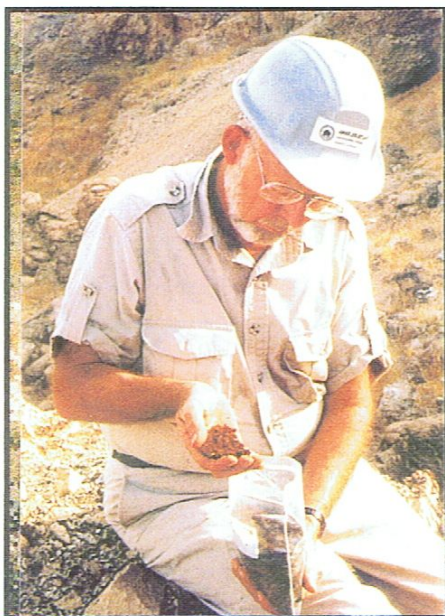
INTRODUCTION

HISTORICAL SUMMARY

During excavations at Qumran in 1992, volunteers working for Vendyl Jones Research Institutes discovered a cache of reddish-brown substance that was later identified as organic material consisting of several spices. These "spices" were culturally "stored" in a rock silo. A coin from the 3rd year of the First Jewish Revolt (i.e. 67-68 C.E.) had been placed in the spices and then the silo was sealed with an eleven-layer cultural dome (see the Report of Vendyl Jones).

The preliminary determination as to the organic nature of the substance was made by Larry Banks, Senior Archaeologist, US Army Corps of Engineers and President of the Society of Professional Archaeologists (SOPA). Larry Banks was the staff archaeologist for I.J.C.R. during the 1992 excavation when the substance was discovered. After his initial determination, a sample of the material was delivered to Dr. Ya'acov Arkin at the State of Israel Institute of Geology. Dr. Arkin and his staff confirmed that the substance was in fact purely organic and recommended a biochemical analysis of the material. Dr. Rabbi Marvin Antelman and Dr. Yehuda Mazur of Weitzman Institute simultaneously examined the substance for qualitative and quantitative chemical makeup. Mass spectrometry tests performed by Drs. Antelman and Mazur confirmed the presence of the chemical composition of eight spices.

The atomic fingerprint of these chemicals was identical to that which would have been contained within at least nine ingredients comprising what is referred to as Qetorit or "Temple Incense." However, according to Dr. Antelman, a positive identification of the actual spices was not possible at this level and a detail analysis on a paleobotanical level was therefore necessary (personal communication - Dr. Rabbi Marvin Antelman).



SUMMARY OF ANALYSIS

The purpose of this analysis and subsequent report is to authenticate the organic nature of the recovered reddish-brown substance, identify the individual organic constituents, and relate the results of that paleobotanical analysis.

The authentication and substantiation was accomplished utilizing standard palynological techniques. A literature survey was also performed and presented in the form of a preliminary report to V.J.R.I. in 1992 (See enclosed supplement pages "Preliminary Analysis 1992." The additional analysis contained herein was performed on-site in Israel in 1994 and consists of a direct comparison to organic (spice) samples collected from various local sources.

These organic samples are presently identified by known Latin (English) and Hebrew nomenclature and have known places of origin.

Using this direct comparison of modern organics (presently available spices) to the ancient spices (recovered at the north entrance to the Cave of the Column in 1992) it is now possible to positively identify the substance.

The substance found by V.J.R.I. consists of, and is identical to the precise botanical ingredients that were used in the manufacture of the Qetorit! It is interesting to note, however, that the red-brown substance was found to be a "pre-mix" of the Qetorit, for lack of a better term, since it contained only nine of the eleven ingredients found at the site. The two remaining inorganic ingredients, while present in the cave, remained separate and apart from the mixture of red-brown substance.

CONCLUSION

The reddish-brown substance found at the north entrance (or "spice cave" as it is now referred) contains only nine of the eleven ingredients in the Qetorit. Therefore, it is technically not Qetorit. However, it is a pre-mixed portion of the Qetorit that is for all intents and purposes ready for "final assembly."

Specifically, the "formula" for manufacturing Qetorit would require the two additional inorganic ingredients that were also found at the site. These two additional inorganic ingredients were found in a refined state and were effectively ready for incorporation into the organic portion.

METHODOLOGY PROCESSING

The spices that were recovered from the cave were processed utilizing standard palynological techniques. Chemicals used in the analysis consisted of 40% Hydrochloric Acid (HCL), 70% Hydrofluoric Acid (HF), 30% Nitric Acid (HNO₃), 20+ % Potassium Hydroxide (KOH), 5% Cellosize (fixative), Elvacite w/ Toluene (mounting medium), and 95% Pure Grain Alcohol.

Approximately 1 tablespoon of the recovered spices were utilized for primary palynological processing with Hydrochloric and Hydrofluoric acids. The resulting organic slurry was sieved and subdivided into varying micron size fractions of above 75 microns, 75-35 microns, 35-10 microns, 10-5 microns, and below 5 microns. These sieved size fractions were mounted on glass slides with cover slips for viewing under the light transmission microscope. Portions of the sieved fractions were also treated with the Nitric Acid and Potassium Hydroxide, and mounted similarly.

PROCESSING NOTATION

The spices that were recovered were uniformly and finely ground. Approximately ninety eight percent of the spices subject to analysis were less than 200 micron size fraction, with the majority falling between 150-35 microns.

The addition of Hydrochloric Acid to the sample naturally resulted in a drastic pH shift to the organic (spice) slurry. The result of this shift was a pleasant but unexpected aroma coming from the spice sample slurry.

The following personal observations on the aroma, while of no quantitative scientific value, may be considered of value for this report:

The aroma released from the "spices" during its processing was profuse and almost immediate. It initially saturated my hands as well as the clothes that I was wearing. Within a matter of minutes my laboratory and the surrounding area (for an area of several meters) was affected by the scent

released from the "spices." The intensity of the odor also awakened my dog (a miniature Dachshund) who was asleep in her bed in the lab. On the first day of processing, the aroma was so intense that I could almost "taste" it (perhaps this was the original effect during Temple times). In any case, that evening, upon my return home, the scent that had attached itself on my body and clothes was readily apparent to both my wife and daughter. During the course of the week, the odor lessened slightly but was still noticeable in and around my lab. Within a few weeks the distinct aroma of the spices diminished to a "freshness or cleanness" of the air in my lab and the surrounding area. This aroma was in evidence, if even so slightly, for approximately two months. On days of high humidity the aroma would return with greater intensity.

RESULTS OF THE ANALYSIS

The preliminary investigation of the recovered spices indicate that the organic sample is composed almost entirely of a fine ground organic mass. A very minor constituent of the spice sample is a dolomite "rock dust," the probable result of collection techniques at the Qumran storage site, ash of unknown origin (Plate 4, figure 6) and an errant laboratory contamination of Ragweed pollen (Plate 1, figure 4).

The red-brown/spice sample is composed of nine different and unique plants. These plants are recognizable both by pollen and organic maceral types.

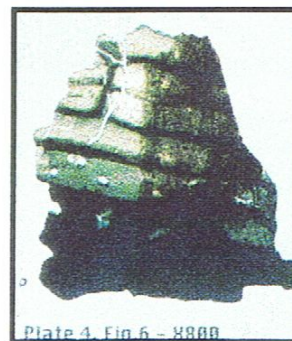


Plate 4, figure 6

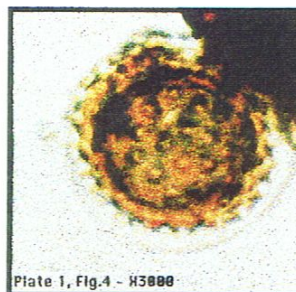


Plate 1, figure 4

FLORAL ORGANIC COMPARISONS

Crocus sativus
Saffron (English) or
Karkom (כַּרְכֹּם)(Hebrew)
A flowering plant of the
Family Iridaceae



spring crocuses).

The type of Crocus (Saffron) which appears in the Qetorit is not to be confused with the variety cashmirianus which is much larger and imported from India.

In the Bible karkom is mentioned once among the various spices that grew in the imaginary spice garden to which the charms of the beloved are compared (Song 4:14). Most of them are enumerated in an early baraita as ingredients of the incense used in the Temple (Ker. 6a; v. *Pittum ha-Qetorit*). Seven species of crocus, some with very beautiful flowers, grow wild in Israel.

The form of Saffron in the spice sample is directly comparable to and the same species as the traditional blue blossomed Saffron (*Crocus sativus*). However, the saffron in the spice sample is of a slightly differently botanical variety which has a red pistil and a reddish-blue to lavender flower. It should be noted that the slight varietal shift, of the spice Saffron in the spice sample, in difference to the modern day cultivated Saffron (*Crocus sativus* var. *cashmirianus*), does not change the species diagnosis and analysis

The portions of the Crocus that is collected, and termed as Saffron, are the three reddish styles of the pistil of each flower blossom. These styles are subsequently sun dried before sale. It takes approximately 150,000 to 250,000 of these styles to produce one kilogram of dried Saffron.

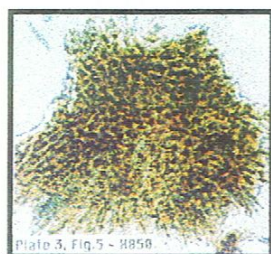


Plate 3, figure 5

The Saffron (Karkom כַּרְכֹּם) (Sanskrit kurkuma) (Greek and Latin krokos) (Aramaic and Arabic zafrana) in the "spice" sample is perhaps the easiest to recognize/identify due to the particular flower portion of the plant that was utilized (Plate 3, figures 5 and 6)

which contain much pollen.

This plant is indigenous to the Mediterranean and Asia Minor and is a member of the Iris family. This type of Crocus flowers with blue flowers blooms in the autumn (which is different from the more familiar

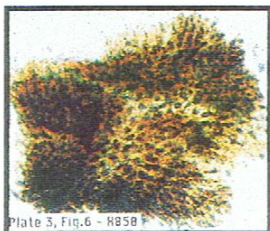


Plate 3, figure 6

Safflower (False Saffron)

Safflower, also called "poorman's saffron," is often used as a merchants substitute for the expensive Saffron. The petals are dried and sold, as is, or ground and formed into irregular masses for sale. This should not be substituted for Saffron in the Qetorit. Only purchase dried and complete reddish styles of the Crocus sativus to be sure that Saffron is obtained and not Safflower.



Cinnamomum Verum

(formerly *Cinnamomum zeylanicum*,
Hepper-1992)

Cinnamon (English) or
Kinnamon (קִנְמון) (Hebrew)

*A small tree of the
Family Lauraceae*

The Cinnamon (Kinnamon קִנְמון) "portion" in the "spice" sample is perhaps the most robust organic maceral (Plate 1, figure 2, and Plate 3, figure 2) due to the particular part of the plant that was utilized, the thin inner bark on young Cinnamon branches.

Plate 3, figure 2

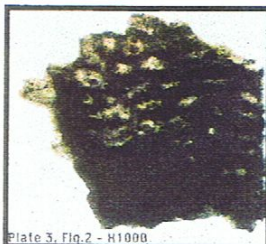


Plate 3, Fig. 2 - H1000

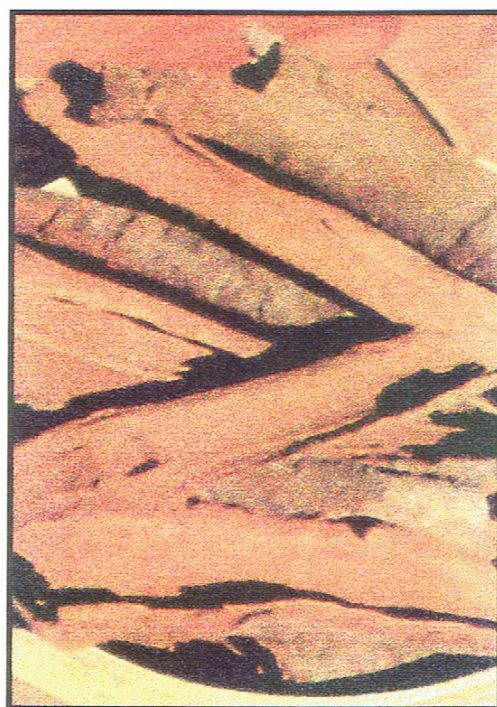


Plate 1, Fig. 2 - H250

Plate 1, figure 2

This plant is indigenous to China and Asia Minor and is a member of the Laurel family.

It was not found in Israel in ancient times, but brought from China (Chinese *kuei-chih*) by the Phoenician and Arab caravan merchants. Cinnamon was acquired for its culinary use, as well as its use in the perfuming of oils.



Three parts of the cinnamon plant/tree are found in the Qetorit. These are the thin inner bark on young cinnamon branches four to five years old (the most common form of cinnamon found in the spice markets called Kinnamon in Hebrew), the thin outer bark of young branches (*Kilupa* in Hebrew), and the tender new growth portion of young branches, including leaves (*Kosht* in Hebrew).

Cinnamomum verum grows into an enormous tree, but the desirable positions described above are acquired from plants grown as bushes.

The "Cinnamon" in the spice sample is directly comparable to and the same species of the traditional sweet-smelling bark of *Cinnamomum verum*.

Cinnamon (Hebrew קִנְמון *kinnamon*; also called in the Bible *kezi'ah* and *kiddah*), a spice. *Kinnamon* or *kinneman besem* ("sweet cinnamon") was one of the ingredients of the "holy anointing oil," used for anointing the Tent of Meeting and its vessels, as well as the high priest Aaron and his sons (Ex. 30:22-32). According to a *baraita* dating from the Second Temple period (Ker. 6a and parallel passages), cinnamon was one of the ingredients of the incense used in the Temple, although it is not included in those enumerated in the Bible (Ex. 30:34ff.). Cinnamon was a costly spice and its source was a closely guarded secret.

Cinnamomum verum
(formerly *Cinnamomum zeylanicum*,
Hepper-1992)

Cinnamon Bark (English)
or Kilupa (Hebrew)
A small tree of the
family Lauraceae

The Cinnamon Bark (Kilupa) "portion" in the "spice" sample is a different part of the same species of plant (Cinnamon) as described above. Quite literally this portion is the outer bark of young branches of the Cinnamon tree (Plate 4, figure 1 and 5). It should be noted that the Cinnamon Bark in the spice sample was thin and almost transparent, possibly the result of the plant being grown as a bush.



Plate 4, figure 1

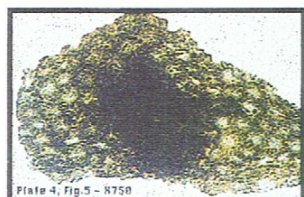


Plate 4, figure 5

This plant is indigenous to China and Asia Minor and is a member of the Laurel family.

Costus (English)
or Kosht (Hebrew)

The Costus (Kosht) "portion" in the "spice" sample is a different part of the same species of plant (Cinnamon) as described above. Quite literally this portion is the new growth of young branches (Plate 4, Figure 2), including leaves



Plate 4, figure 2

(Plate 3, figure 4) of the Cinnamon tree.

This plant is indigenous to China and Asia Minor and is a member of the Laurel family.

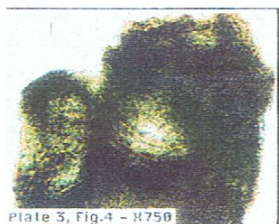


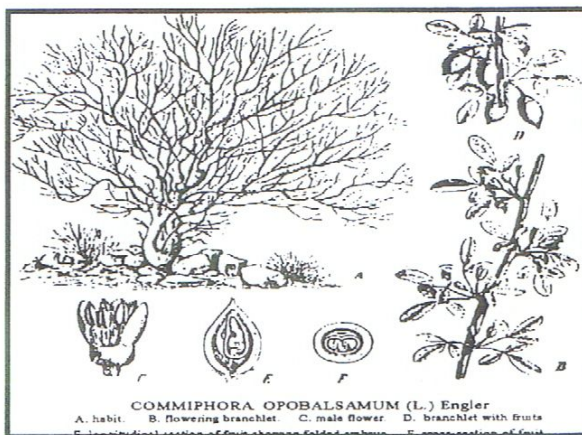
Plate 3, figure 4

Commiphora opobalsanum
Balsm/Balm (English)
or Zori (Hebrew זָרִי)

often referred to as "Judaic Balsum"

A small tree of the
Family Burseraceae

COMMIPHORA OPOBALSAMUM (L.) EnglerA. habit.



B. flowering branchlet. C. male flower. D. branchlet with fruits E. longitudinal section of fruit showing folded embryo. F. cross-section of fruit.



Plate 2, figure 7



Plate 2, figure 8

The Balsm/Balm (Zori זָרִי) in the "spice" sample is composed of small straw yellow "pearls" of dried resin/sap. (Examples of "Commiphora style resin pearls" are figured in Plate 2, figures 7 and 8). Within these resin pearls, macerals of waxy bark/cuticle (Plate 2, figure 5) and indigenous pollen are recovered (Plate 1, figure 3).

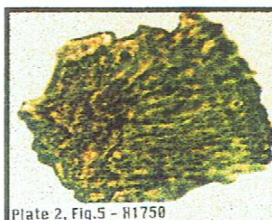


Plate 2, figure 5

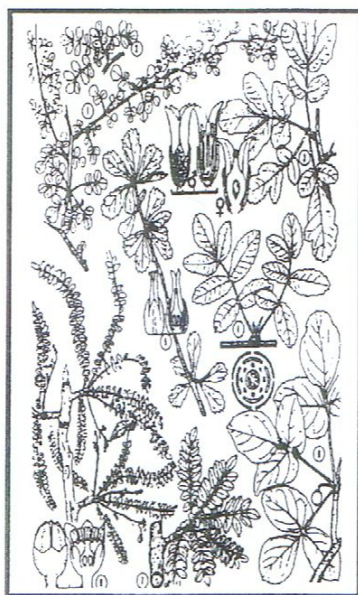


Plate 1 figure 3

According to Josephus (Ant., 8:174-5), balsam was originally brought to Eretz Israel by the Queen of Sheba as one of the gifts included in the "hundred and twenty talents of gold, and of spices very great store, and precious stones: there came no more such abundance of bosome" (I Kings 10:10). Generally, in the Bible, bosome signifies spices of all kinds. Balsam was cultivated until approximately 500 C.E. Recent investigators have attempted to equate Balsam/Balm (Zori) with the Balm of Gilead (*Commiphora gileanensis*), a theory which this analysis totally refutes after examining the recovered spices by Vendyl Jones.

This plant is believed to be indigenous to Ethiopia, Somalia and southwest Arabia, and is a member of the Burseraceae family. The most aromatic varieties of this plant are found at or below sea level in arid regions. At the present the tree grows wild in the valley of Mecca where it is called beshem. Many strains of this species are found, some in Somalia and Yemen.

Balsam was designated in the Bible by various names: בֶּשֶׂם (bosem), בֶּשֶׂם (besem), נָטָף (nataf) and in rabbinic literature as קָטָף (kataf), בֶּלֶסָם (balsam), אֶפּוֹבָלְסָמוֹן (appobalsamon), אֶפְרָסֶמוֹן (afarsemon) which occurs most frequently in the Talmud and Midrash, designating the perfume extract from the sap of the *Commiphora opobalsamum*. It was the only tropical, and the most expensive, spice grown in Eretz Israel.



7. *Boswellia ? hil-debrandtii*;

8. *Boswellia hil-debrandtii* with side view and longitudinal section of flower (bottom left).

BURSERACEAE: 1. *Commiphora opobalsamum*;

2. *Commiphora* sp.;

3. *Commiphora* sp. with side view and longitudinal section of male flowers (upper center) and longitudinal section of a female flower;

4. *Commiphora oga-densis* with floral diagram;

5. *Commiphora flavi-flora* with side view and longitudinal section of female flowers (center);

6. *Commiphora lughensis* with a solitary fruit;

Commiphora myrrha myrrha Myrrh (English) or Mor (Hebrew מור)

*A small thorny branched shrub
tree of the Family Burseraceae*



Fully grown *Commiphora myrrha myrrha* comprises sizeable bushes or small trees. The branches are thorny and covered with small leathery leaves. A cut is made in large branches or the trunk from which resin oozes and harden, often falling to the ground for collection. The aromatic resins white to yellowish in color, often clear to translucent, yet oily in consistency.

Myrrh was one of the most important perfumes of ancient times. It is referred to 11 times in the Bible, more than any other perfume. The Hebrew *mor*, refers to its bitter taste (*mar*, "bitter"): the root is common to the various Semitic languages, from where it was transferred to Greek *Murr* and Latin *myrrha*. It is first mentioned along with the ingredients from which the holy anointing oil in the Tabernacle was prepared (Ex. 30:23-25), where it is called *mor deror*, i.e. myrrh congealed to form granules (*deror* from *dar*, "pearl") and then dissolved in oil.

The *Myrrh (Mor)* in the "spice" sample is composed of small "pink to reddish pearls" of dried resin/sap. (Examples of "*Commiphora* style resin pearls" are figured in Plate 2, figures 7 and 8). Within these resin

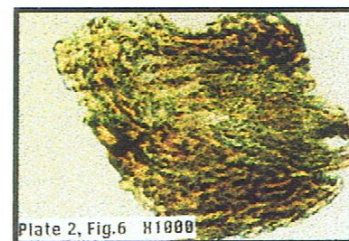


Plate 2, figure 6

Plate 2, Fig.6 H1000

pearls, macerals of waxy bark/cuticle (Plate 2, figure 6) and indigenous pollen are recovered.

Resins commonly referred to as "myrrh" have been found to represent several of the 135 species of *Commiphora*.

A comparison of standard botanical/palynological literature with the variety of *Myrrh* (Mohr) separated from the recovered spice indicated the closest affinity with the form *Commiphora myrrha myrrha*. (aff.var. *abyssinica simplicifolia*).

This plant is indigenous to hot areas of Africa, Madagascar, Arabia, Somalia (ancient Punt), Yemen and West India. The most aromatic varieties of this plant are found in the most arid regions of their habitat.

Ferula galbanifula
Galbanum (English)
 or Helbenah (Hebrew חֶלְבָּנָה)
A small tree of the
Family Umbelliferae



The *Galbanum* (*Chelbona*) in the "spice" sample is composed of small pinkish brown nodules "pearls" of dried resin. These dried "pearls" have a most peculiar shape to their formation when sectioned and studied through the light transmission microscope. This peculiar shape is possibly a result of the resin being collected from the lower parts of the stem



Plate 3, Fig.1 - 8750

Plate 3, figure 1

at the thick base of the leaves. (An example of a "Galbanum" style resin pearl" is figured in Plate 3, figure 1). Within these resin pearls indigenous pollen are recovered.

There are 135 known species of *Ferula*, most of which are found in the countries of the Mediterranean and in west central Asia. In regions where *Ferula galbanifula* grow, the plant is immediately noticeable because of its large branched stalks. It is the presence of stalks (in difference to woody stems), that causes the peculiar of the nodules ("pearls") of dried resin. This plant is related to the fennel and parsley, herbs also used in foods throughout the area.

Galbanum (Hebrew חֶלְבָּנָה) is a gum resin mentioned among the ingredients of the incense in the Tabernacle (Ex. 30:34) and by Ben Sira as a spice (Greek calbavnh). It was included in a *baraita* (Ker. 6a), dating from Second Temple times, among the constituents of the incense used in the Temple. The Gemara (Ker. 6b) states that it was an ingredient of incense despite its offensive smell, thus demonstrating that a malodorous substance, when mixed with fragrant spices, also contributes to the general pleasant odor. Today, in Israel, six species of *galbanum* grow wild, but their resin is not used for any known purpose.

Acorus calamus
Cassia (English)
 or Ketzia (Hebrew)
A grass of the Family Araceae



The genus *Acorus* is one of the more primitive members of the Araceae family, and as such has primitive, plain flowers which are not very noticeable. The root stocks of this plant were dried and transported throughout the spice-route of the Mediterranean and Middle East as both medicinal and aromatic agents.

Today the root stocks of the Cassia (*Calamus*) are widely used in the preparation of various alcoholic beverages, such as, for example the Dutch gin "Beerenburg."

The Cassia (*Ketzia*) in the "spice" sample is composed of somewhat pithy root stocks (Plate 4, figure 3) with a paper thin, yet hard "root wall" covering (Plate 4, figure 4).



These root stocks are very fragrant with an odor similar to Cinnamon (Kinamon), hence, the oft associated phrase "bastard cinnamon."

Plate 4, figure 3

Recovered pollen from *Acorus calamus* (Plate 1, figure 1) in the spice sample is quite rare. This in part maybe a result of the plants propagation by the splitting of root stalks, along with the poor development of flowers.

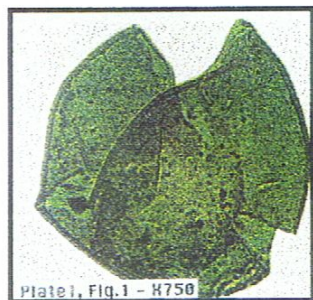


Plate 1, figure 1

This plant is indigenous to the countries of the Mediterranean, Asia Minor, India, China and Europe, and when mature only slightly resembles other plants from the Arum family. *Acorus calamus* bears no resemblance palynologically to Himalayan perennials *Saussurea costus* or *Saussurea lappa* (of the daisy family *Compositae*), which has on occasion been cited as the basis for Cassia (*Ketzia*).

It is one of the spices from which the aromatic oil in the Tabernacle was prepared (Ex. 30:23).

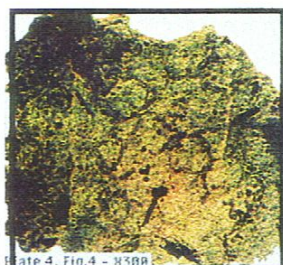


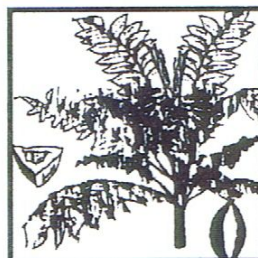
Plate 4, figure 4

Boswellia sacra

(var. *sacra*, var. *carteri*,

var. *frereana* and var. *papyifera*)

Frankincense (English)
or Levonah (Hebrew לבונה)



A small single stemmed tree or shrub of the Family Burseraceae

The Frankincense (Levonah) in the "spice" sample is composed of pure pale-yellow to whitish fragments of gums and dried resin/sap (Plate 2, figure 3). Within these resin pearls woody macerals of bark/cuticle and indigenous pollen are recovered. Modern resins, purchased in the spice markets and commonly referred to as "Frankincense," are often compound mixtures of resins of many combinations of the fifteen species of the genus *Boswellia*. A common species of *Boswellia* that is most often used as an adulterer for "pure" Frankincense (Levonah) is *B. serrata* from India.

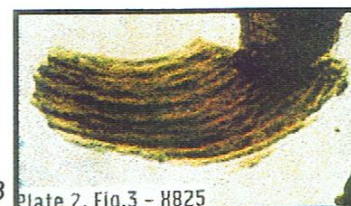
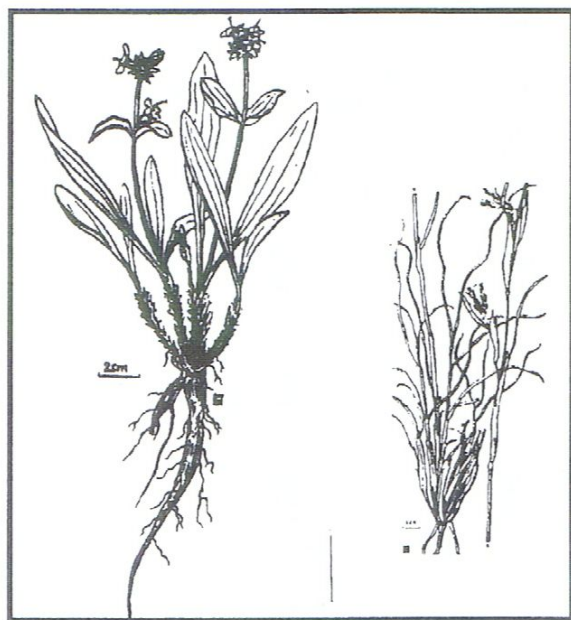


Plate 2, Figure 3

Boswellia sacra is indigenous to Arabia and the arid countries of east Africa. In Arabia Frankincense (Levonah) is referred to as "luban" (meaning milk), in reference to the milk-like look of the fresh resin.

Frankincense (Hebrew לבונה) was the chief ingredient of the Temple incense. It is mentioned a number of times among the treasures of the Temple (Neh. 13:5; 1 Chron. 9:29). It was burnt with the sacrifice of meal offering (Lev. 2:1) and placed upon the rows of showbread (Lev. 24:7)

Nardostachys jatamansi**Spikenard (English)****Shibolet naird****or Nerd (Hebrew נִרְד)***A herbaceous perennial herb of the Family Valerian.*

The Spikenard (*nerd*) in the "spice" sample is composed dominantly of small flowers. These flowers are small, violet to blue in color, and end with a terminal spike. The cellular structure of the Spikenard flower maceral has a peculiar rhomboid shape that is quite distinct among the nine spices (Plate 3, figure 3). Due to a thin husk, the spikenard is also the most difficult of the nine recovered spices to grind to a

fine consistency. It should also be noted that several complete flowers of the Spikenard were recovered intact in the "spice" samples of Qumran.



Plate 3, figure 3

In Biblical times Spikenard was used as an aromatic ointment, where its stems, together with the tap root were also collected. It should be noted that Camel grass (*Cymbopogon schoenanthus*) was cited by Hepper (1992) as being the parent plant of the 'nard' in Song of Solomon 4:13.

Spikenard (belonging to the Valerian family of herbs) was originally referred to as *Valeriana jatamansi*. Palynologically, the plant appears to be quite similar to lavender. Tshudy (1982) suggested the plants emendation into the perennial herb family of Labiatae, and a further generic emendation to *Lavandula jatamansi*.

This plant is indigenous to western and northern India where it is called "Jatamansee," and Nepal where it is called "Narda" or "Nalada."

According to an ancient *baraita*, spikenard was one of the 11 spices from which the Temple incense was prepared (Ker. 6a).

Styrax officinalis**(?var.benzoin)****Onycha (English)****Tziporen (צִפּוֹרֵן)****or Shehelet (Hebrew שֶׁחֶלֶת)***A small tree or shrub of the Family Styracaceae*

Plate 2, figure 4

The *Onycha* (*Tziporen*) in the "spice" sample appears to be composed of straw-yellow fragments of gums and dried resin/sap (Plate 2, figure 4). Within these resin "pearls," woody macerals of bark/cuticle and indigenous pollen (Plate 1, figures 5 and 6) are recovered.

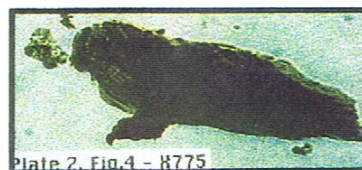


Plate 2, Fig.4 - R775

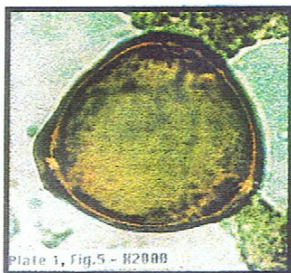


Plate 1, figure 5

It has been suggested that in addition to "resin pearls," resins are obtained by the crushing of floral buds and the collections of "resin scales" from leaf clusters and bases.

ingredients of the incense in the Temple, while in Ugaritic writings it is mentioned among several spices and foods.

ADDITIONAL OBSERVATIONS

The palynological investigation confirmed that the reddish-brown substance was organic and indeed consisted of very specific "spices." Moreover, the spice was composed of floral elements, with a complete absence of faunal components (an assessment also confirmed by chemical analysis).

The analysis of the floral elements led to the conclusion that the "spices" were composed of eleven ingredients from nine distinct species and that three separate components of a single species of Cinnamon were actually used in the mixture.

Plate 1, figure 6



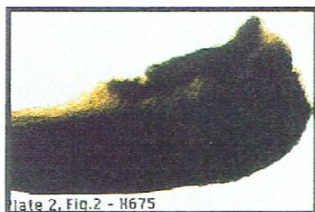
Fragments of *Onycha* (Tziporen) probable "resin scales" are pictured in Plate 2, figures 1 and 2. Modern resins, purchased in the spice markets, and commonly referred to as "Onycha," are often compound mixtures of resins of both *Styrax officinalis* and *Styrax benzoin*. It should be noted that from a palynological assessment there is great similarity with *Onycha* (Tziporen) and the family of plants Myrtacea {specifically cloves (*Syzygium aromaticum*)}.

Plate 2, Figure 1

This plant, referred to here as *Styrax officinalis*, is the only member of the *Styrax* genus which has its natural habitat in arid regions of the Mediterranean Basin and Arabian Plateau, while *Styrax benzoin*, present day, is known only from Malacca, Sumatra and Java.



Plate 2, Figure 2



According to the ancient translations, the *shehelet* included among the ingredients of the incense (Ex. 30:34) is onycha. An early *baraita* dating from Temple times has צִפּוֹרֶן (Tziporen) ("fingernail") instead of *shehelet* (Ker. 6a). The reference to the shell of a mollusk, the *Unguis odoratus* (shaped like a fingernail and hence the name) which is found in the Indian Ocean, and, like several other mollusks found in the Red Sea, emits a pleasant smell when burned. Ben Sira 24:15 also includes onycha (in Greek ὄνυξ as one of the

RECOMMENDATIONS FOR FURTHER STUDY

The excellent preservation of the "spices" recovered at the Cave of the Column is evidenced by the physical integrity of recognizable and identifiable palynomorphs and organic macerals. This excellence of preservation will allow the researcher to study botanical affinities to a varietal specific level, and thus, reverse engineer the substance. Though time consuming, this would result in the ability to duplicate the "spice" mixture, and eventually, if desired, the Qetorit itself.

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Plate Descriptions

Refer to text -- *Floral Organic Comparisons*

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